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### Optical methods for the assessment of microvascular perfusion and oxygenation

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## **OUTLINE OF THE THESIS**

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## OUTLINE OF THE THESIS

The research presented in this thesis has been conducted as part of a collaboration of the Department of Translational Physiology of the Academic Medical Center of the University of Amsterdam and the Department of Intensive Care of the Erasmus Medical Center of the University of Rotterdam. The aim of this collaboration is to 'translate' clinical scenarios into (patho)physiological concepts (and vice versa) and to develop therapeutic strategies based on insights obtained in the clinic and in the lab. As the microcirculation has an important role in both health and disease, the main emphasis of our research is on this key physiological compartment. Our clinical research line is focused on investigating the sublingual microcirculation in surgical and critically ill patients and to test the effects of therapeutic strategies aimed at improving the microcirculation. Our animal research line is focused on investigating the renal microcirculation and renal function in several clinically-relevant models of renal ischemia/reperfusion injury, hemorrhagic shock, and endotoxemic shock. The purpose of the work described in this thesis is to support the clinical and experimental research at our department by developing and validating new and available technologies that aid the assessment of microvascular perfusion and oxygenation in patient and animal studies.

**Part I** of this thesis is on the assessment of microvascular perfusion: **Chapter 1** introduces and validates sidestream dark field (SDF) imaging for clinical assessment of the microcirculation; **Chapter 2** improves SDF image acquisition with an image acquisition stabilizer; **Chapter 3** improves SDF image analysis with rapid and fully automatic methods for microvascular density and perfusion assessment; **Chapter 4** validates laser speckle imaging (LSI) for assessment of microvascular perfusion by quantitative comparison to SDF imaging; and **Chapter 5** evaluates the use of LSI for the assessment of renal microvascular perfusion histograms.

**Part II** of this thesis is on the assessment of renal microvascular oxygenation during endotoxemia; **Chapter 6** employs multi-level phosphorimetry for studying microvascular and interstitial oxygen tensions in the renal cortex and medulla during endotoxemia; **Chapter 7** validates phosphorimetry for the recovery of microvascular oxygenation histograms using multi-exponential curve fitting analysis; and **Chapter 8** combines microvascular perfusion histograms as obtained with LSI (Chapter 5) with microvascular oxygenation histograms as obtained with phosphorimetry (Chapter 7) to gain more insight into the role of microcirculatory dysfunction in endotoxemia-induced acute kidney injury.